radiant is high in the sky. If the radiant is low, or if the sky is bright (for instance from moonlight), the number of meteors visible will be very much less.

METEOR SHOWERS

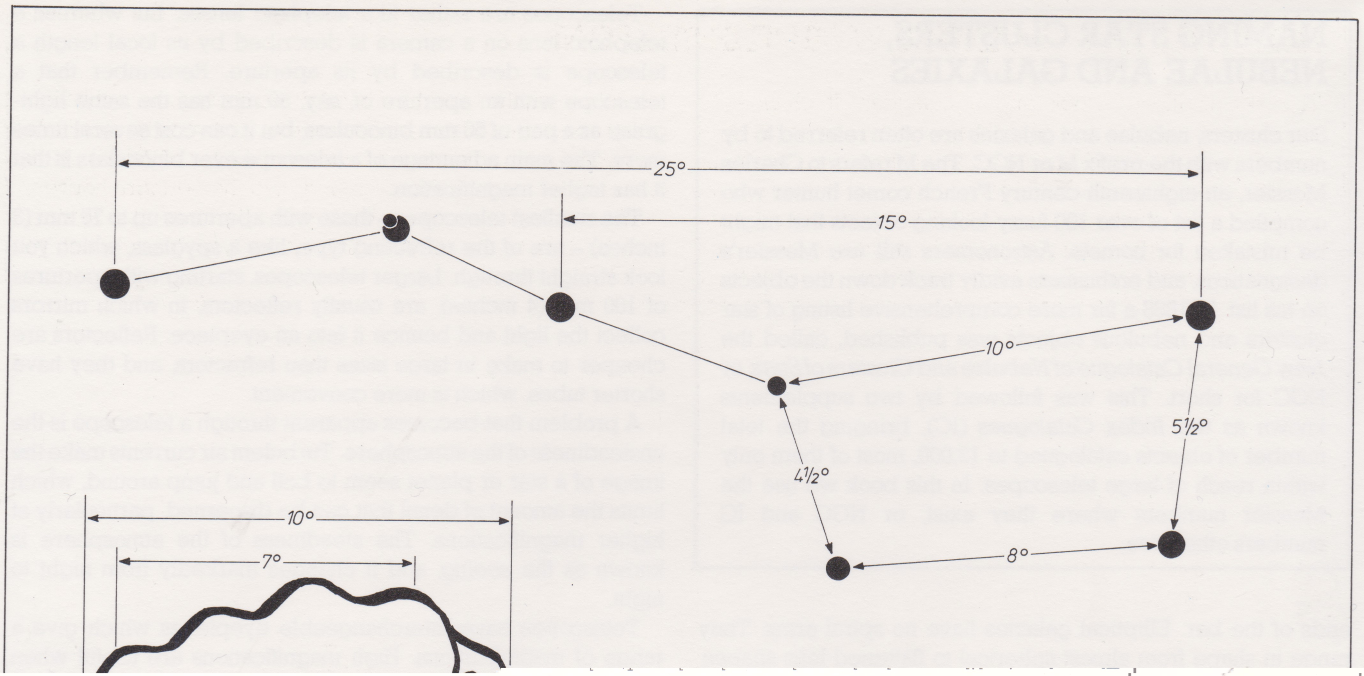
Name of shower	Date of maximum	Number of meteors visible per hour at maximum (approx.)
Quadrantids	January 3–4	100
Lyrids	April 21–22	15
Eta Aquarids	May 5–6	40
Delta Aquarids	July 28–29	20
Perseids	August 12	60
Orionids	October 21	20
Taurids	November 3	12
Leonids	November 17–18	10
Geminids	December 13–14	60

What is a comet?

What is a star cluster?

In places, stars congregate in clusters, some of which are visible to the naked eye, most notably the group called the Pleiades in the constellation Taurus. There are two sorts of star cluster, distinguished by the types of stars in them and their location in the Galaxy. *Open clusters* are loose groupings of young stars dotted along the spiral arms of our Galaxy. Some open clusters, such as the Pleiades, are still surrounded by traces of the gas clouds from which they were born. Open clusters contain from a handful of stars up to a few thousand stars.

Altogether different in nature are the ball-shaped *globular clusters*, mostly found well away from the plane of the Milky Way. They are swarms of up to 300,000 stars, much more tightly bunched together than in open clusters. The stars in globular clusters are very old – indeed, they include some of the oldest stars known. Since globular clusters are much further away from us than open clusters, they appear fainter. The best globular cluster for northern observers is M13 in the constellation Hercules.


25°
15°
10°
5½°
4½°
8°
10°
7°

brightness changes of Betelgeuse by comparing it with other stars, particularly Aldebaran and Capella, from time to time. Various distances are given for Betelgeuse, but a more recent determination places it just over 300 light years away, closer than previously thought.

Compare Betelgeuse with the blue-white star Rigel at the bottom right of the constellation. Rigel marks Orion's left leg, and not surprisingly its name comes from the Arabic meaning left leg. Rigel, also known as Beta (β) Orionis, is the brightest star in Orion, magnitude 0.1. It, too, is a supergiant, but it has a much hotter surface, which accounts for its difference in colour from Betelgeuse. The temperature of Rigel's surface is 12,000 kelvin, while that of Betelgeuse is a relatively cool 3000 K. Rigel is about 900 light years away, three times farther than Betelgeuse.

Rigel is worth looking at carefully for another reason: it is a double star. It has a companion star of magnitude 6.8 that is difficult to see in the smallest telescopes because of the glare from Rigel itself. The aperture needed to pick out this companion will depend on the steadiness of the atmosphere and how high Rigel is above the horizon. Probably at least 75 mm aperture is required, but the only way to be sure is to go out and see for yourself.

One distinctive feature of Orion is the line of three bright stars that marks its belt. Each of these stars is of second magnitude. Of the three stars of the belt, Epsilon (ε) Orionis (Alnilam) and Zeta (ζ) Orionis (Alnitak) are at a similar distance from us, about 1200 light years, whereas Delta (δ) Orionis (Mintaka) seems about twice as far away. Delta Orionis has a wide 7th-magnitude companion star that is easily seen in small telescopes. At the left end of the belt, Zeta Orionis is a double star that presents a challenge for amateur telescopes. A 4th-magnitude companion lies 2.3 seconds of arc from it; normally, stars this far apart should just be divisible in an aperture of 50 mm, but the difference in brightness between the stars means that at least 75 mm aperture is needed to separate them, as well as a night of steady seeing.

A strip of faint nebulosity, known as IC 434, extends southwards from Zeta Orionis. On one side of this is the celebrated Horsehead Nebula, formed by a cloud of dark dust that is silhouetted against the glowing hydrogen gas behind it. Unfortunately, the Horsehead is virtually impossible to see with even large telescopes, but it shows up well on long-exposure photographs, looking like a celestial chess piece.

A survey of Orion's stellar treasures would be incomplete without a visit to Sigma (σ) Orionis, lying just below the leftmost star of the belt. To the naked eye Sigma Orionis appears as an unremarkable star of 4th magnitude, but small telescopes reveal it to be flanked by three fainter stars, looking like a planet with moons. Also visible in the same field of view is a triple star, Struve 761, which consists of a narrow triangle of 8th- and 9th-magnitude stars. This rich telescopic sight is one of Orion's unexpected delights.

One reason for Orion's prominence is that most of its stars lie in a nearby spiral arm of the Galaxy where new stars are still being born. The centre of starbirth in this region is the Orion Nebula, 1300 light years away, which appears as a misty patch to the naked eye; it marks the sword of Orion, hanging from his belt (see below).

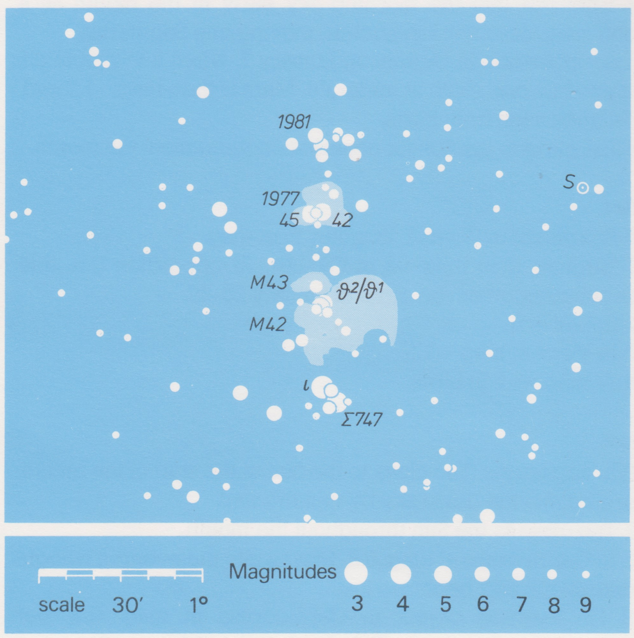
Colour photographs show the Orion Nebula to be a mixture of yellow and red, whereas to the human eye it appears greenish. The reason lies in the different colour sensitivities of the eye and colour film. The greenish colour seen by the eye comes from atoms of ionized oxygen, whereas colour film is better at picking up the reddish emission from hydrogen gas of which the Orion Nebula mostly consists, as do all similar nebulae. Colour photographs give a better idea of the true colour of the Nebula than does the human eye.

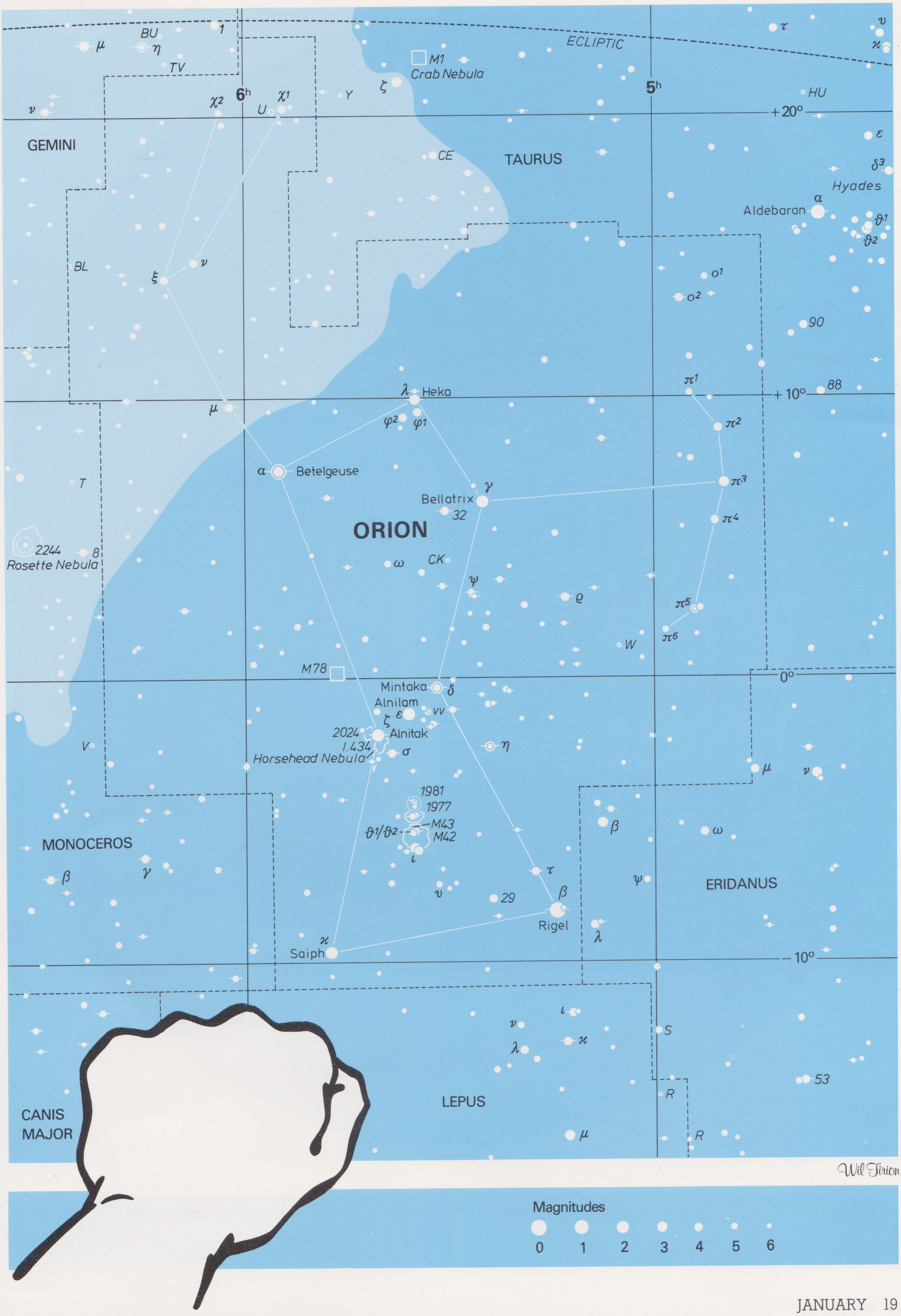
The Orion Nebula is about 20 light years in diameter and contains enough gas to make thousands of stars. If we could turn the clock back 5000 million years to the birth of the Sun we would find that our region of space looked like the Orion Nebula.

THE ORION NEBULA

The Orion Nebula is a luminous cloud of gas, the finest object of its kind in the heavens, also known as M42 and NGC 1976. Wreaths of ghostly glowing gas spread over a degree of sky, twice the apparent diameter of the full Moon, making a sight not to be missed in any instrument. To its north is a smaller patch of gas, M43, alias NGC 1982, actually part of the same cloud. Because the Nebula is so large, binoculars are excellent for viewing it. Embedded at the Nebula's centre is a 5th-magnitude star, Theta-1 (θ^1) Orionis. This star was born recently from the surrounding gas, and it illuminates the Nebula. Home in on Theta-1 Orionis with small telescopes and you will see why it is popularly known as the Trapezium: it consists of four stars of magnitudes 5.1, 6.7, 6.7 and 8.0, arranged in a rectangle. The Trapezium is almost at the tip of a dark wedge in the Nebula known as the Fish Mouth. To the lower left of the Trapezium, binoculars show Theta-2 (θ^2) Orionis, a wide double star of magnitudes 5.2 and 6.5.

This whole area is a complex of nebulosity and young, hot stars, which together comprise the sword of Orion. At the tip of the sword, on the southern edge of the Orion Nebula, is Iota (ι) Orionis, the brightest star in the sword. Iota Orionis is a hot, blue-white giant of 3rd magnitude with a 7th-magnitude companion shown by small telescopes. To the lower right of Iota lies Struve 747, an easy pair of 5th- and 6th-magnitude white stars for small telescopes. Above the Orion Nebula lies a smaller smudge of nebulosity, NGC 1977, containing the 5th-magnitude star 42 Orionis. (Its apparent neighbour, 45 Orionis, is an unrelated foreground object.) Farther north binoculars reveal NGC 1981, a scattered handful of stars of 6th magnitude and fainter, marking the top of the sword handle.




ECLIPTIC
Crab Nebula
M1
6h
5h
+20°
+10°
0°
-10°
GEMINI
TAURUS
Hyades
Aldebaran
ORION
Heka
Betelgeuse
Bellatrix
Rosette Nebula
2244
M78
Mintaka
Alnilam
Alnitak
2024
I.434
Horsehead Nebula
1981
1977
M43
M42
Rigel
Saiph
MONOCEROS
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LEPUS
CANIS
MAJOR
Magnitudes
0
1
2
3
4
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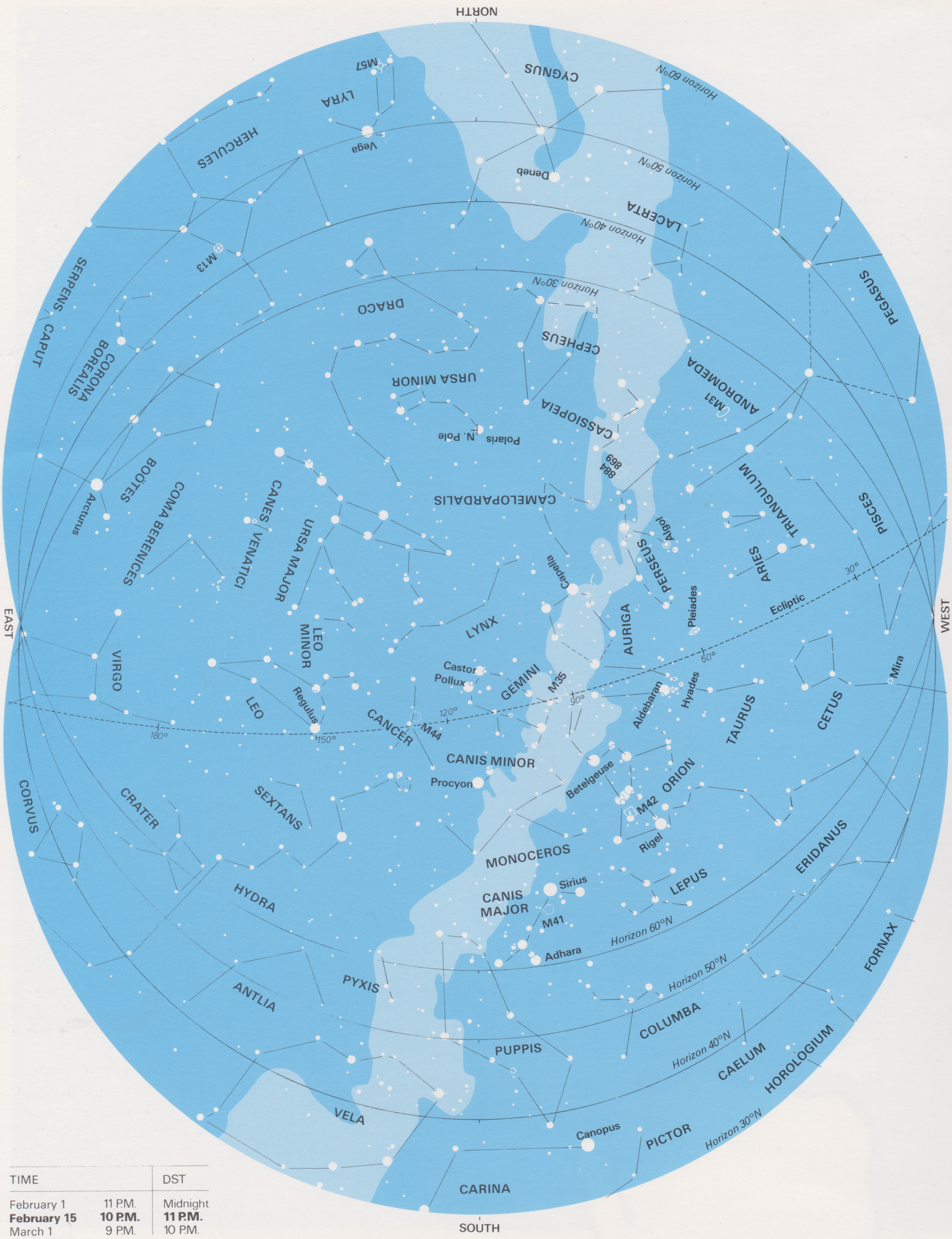
6
Wil Tirion



TIME		DST
February 1	11 P.M.	Midnight
February 15	**10 P.M.**	**11 P.M.**
March 1	9 P.M.	10 P.M.

Magnitudes

−1	0	0	1	1	2	2	3	3	4	4	5
~ 0.5	0.5 0.0	0.1	0.5 0.6	1.0 1.1	1.5 1.6	2.0 2.1	2.5 2.6	3.0 3.1	3.5 3.6	4.0 4.1	4.5 4.6 5.0

Double or multiple stars — Variable stars
Open clusters — Globular clusters — Diffuse nebulae
Planetary nebulae — Galaxies

Wil Tirion

FEBRUARY

KEY STARS

The Winter Triangle formed by Sirius, Procyon and Betelgeuse remains prominent in the evening sky this month. Other stars well-placed for observation are Rigel, in Orion, and Aldebaran, in Taurus, both in the south-west. Castor and Pollux, the twin stars of Gemini, are high in the sky at 10 p.m. Regulus, the brightest star in Leo, is high in the south-east by 10 p.m. At the same time, orange Arcturus is rising on the eastern horizon.

The planets this month

Venus

1990 A brilliant morning object (up to mag. –4.3) in Sagittarius.

1991 Moves from Aquarius into Pisces, in the evening sky.

1992 A morning object, moving from Sagittarius into Capricornus. Passes one degree north of the much fainter Mars on February 20 and is very close to Saturn on February 29.

1993 Reaches its greatest brilliancy in the evening sky this month, in Pisces.

1994 Too close to the Sun for observation throughout the month.

Mars

1990 In Sagittarius, around mag. 1.5. Mars is close to the brighter planet Saturn (mag. 0.8) at the end of February.

1991 In Taurus, north of the Hyades cluster and Aldebaran. Mars fades markedly during this month (from mag. 0.1 to mag. 0.7) as it recedes from Earth, but remains brighter than Aldebaran.

1992 Moves from Sagittarius into Capricornus at mag. 1.5. Brilliant Venus passes one degree north on February 20.

1993 Almost stationary in Gemini, fading rapidly from mag. – 0.7 to mag. 0.

1994 Starts to emerge from twilight into the morning sky at the end of the month.

Jupiter

1990 Mag. –2 or brighter throughout the month. In Gemini, near the borders with Orion and Taurus.

1991 In Cancer at mag. –2, passing in front of the Beehive Cluster (M44).

1992 Bright (mag. –2) in Leo. At opposition (due south at midnight) on February 29, 660 million km from Earth.

1993 In Virgo at mag. –1.9.

1994 At mag. –1.7 in Libra.

Saturn

1990 In Sagittarius. Saturn (mag. 0.8) forms a close pair with the fainter planet Mars (mag. 1.5) at the end of the month.

1991 Emerges from twilight into the morning sky in the first week of February, in Capricornus.

1992 In Capricornus. Moves into the morning sky in mid-month at first mag. Brilliant Venus passes close on February 29.

1993 Too close to the Sun for observation throughout the month. At conjunction (directly behind the Sun) on February 9.

1994 Vanishes into the evening twilight at the beginning of the month. At conjunction (directly behind the Sun) on February 21.

Canis Major

In the south this month sits the constellation Canis Major, the Greater Dog, home of Sirius, the brightest star in the entire sky. Canis Major and nearby Canis Minor repesent two dogs following at the heels of Orion. Surprisingly, the only object of significance in the Lesser Dog, Canis Minor, is its brightest star, Procyon; hence Canis Minor might be termed the lone-star constellation. By contrast, Canis Major is packed with bright stars. On old maps, the dog is depicted as standing on his hind legs, with flaming Sirius (popularly known as the Dog Star) marking his snout.

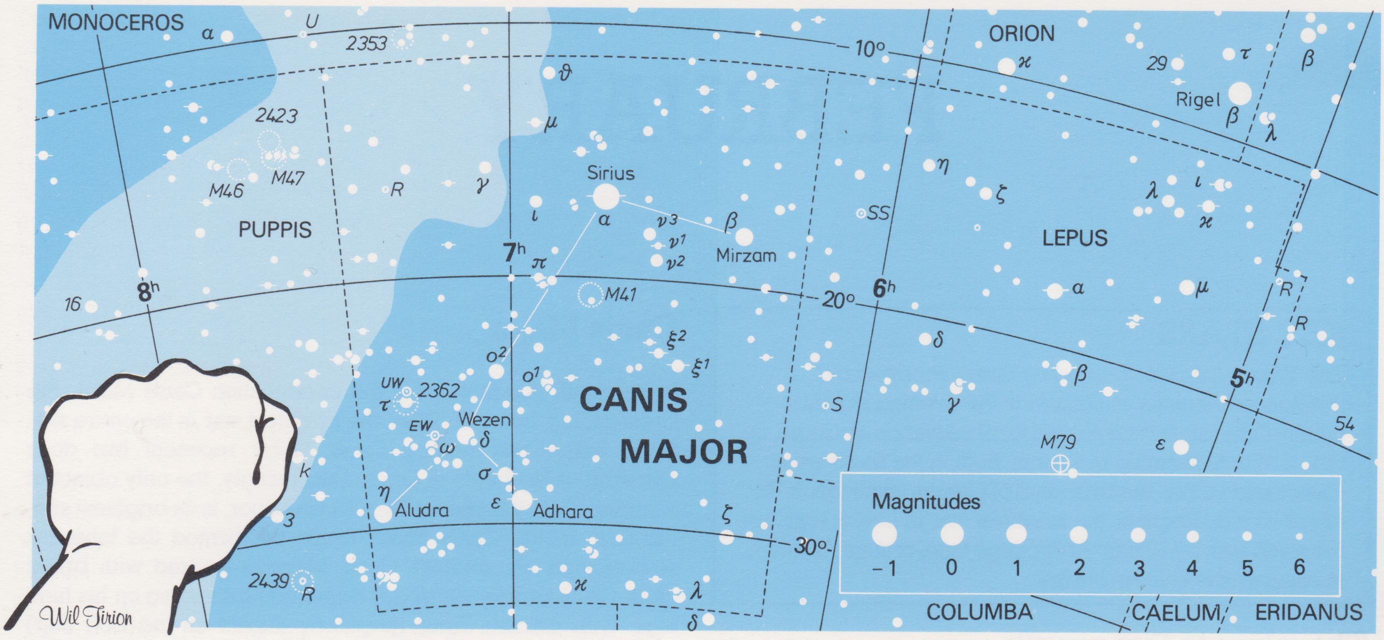
Sirius has a magnitude of –1.46. Its name comes from the Greek meaning searing or scorching, for in ancient times it was actually thought to be a source of heat. The sweltering 'dog days' of high summer were attributed to the Dog Star, for they occurred when Sirius lay close to the Sun. Hesiod, one of the earliest Greek poets, wrote of 'heads and limbs drained dry by Sirius'. Because of the outstanding brilliance of Sirius, its yearly passage around the sky was used as a calendar-marker from at least the time of the ancient Egyptians, over 2000 years BC.

Sirius appears twice as bright as the second most prominent star, Canopus, which can be seen below it at this time of year if you are south of latitude 37 degrees north. The exceptional brilliance of Sirius is due to a combination of its light output and its relative closeness to us. Sirius is roughly twice the mass and twice the diameter of the Sun, and gives out more than 20 times as much light. That by itself is not exceptional. What helps make Sirius so bright in our skies is that it is 8.7 light years away, the fifth-closest star to the Sun. Hence it outshines more powerful stars, such as Betelgeuse in Orion, which are much more distant. Of the stars visible to the naked eye, only Alpha Centauri in the southern hemisphere is closer to us than Sirius.

Sirius is almost pure white, but it twinkles a multitude of colours as its light is broken up by air currents in the Earth's atmosphere on frosty winter nights. In binoculars or a small telescope it is dazzling. Sirius has a bizarre 8th-magnitude companion, a small and dense star of the type known as a *white dwarf* (see box). This tiny companion of the Dog Star has been nicknamed The Pup. Unfortunately, it is so close to Sirius that a large telescope is needed to show it.

Beta (β) Canis Majoris is a blue giant star 720 light years away, magnitude 2.0. It bears the Arabic name Mirzam, meaning the announcer, from the fact that its rising heralds the appearance of Sirius. The second-brightest star in the constellation, Epsilon (ε) Canis Majoris, magnitude 1.5, is another blue giant, 490 light years away.

The real superstar of the constellation, though, is Delta (δ) Canis Majoris, which the Arabs named Wezen, meaning weight. The legend behind this odd name has been lost but it is certainly appropriate, for the star is indeed weighty, with an estimated mass at least 20 times that of the Sun. It is a brilliant supergiant, giving out more than 100,000 times as much light as the Sun, so that it appears of magnitude 1.9 despite its considerable distance of 3000 light years, nearly ten times as far as Betelgeuse.



Almost as impressive is Eta (η) Canis Majoris, another supergiant, 50,000 times more luminous than the Sun. It appears of magnitude 2.4 and is 2500 light years away. If Sirius were removed to such a distance it would appear of 11th magnitude, way below naked-eye visibility. Conversely, if Delta and Eta Canis Majoris were as close to us as Sirius they would each shine as brilliantly as a half Moon, so the night sky would never be truly dark when they were above the horizon.

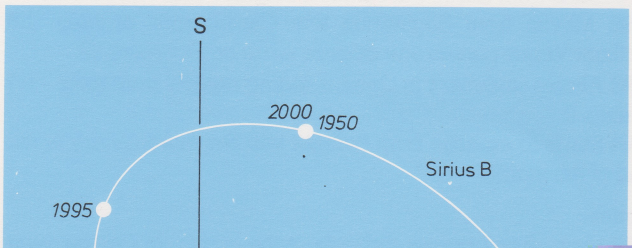
Canis Major contains two attractive star clusters for small instruments. Just south of Sirius is M41, covering the same area of sky as the full Moon. Under good conditions it can even be seen as a fuzzy spot by the naked eye. M41 contains about 50 stars, the brightest of them a 7th-magnitude orange giant. Binoculars pick out the brightest members, and many more are visible in small telescopes. Low magnification is needed to fit all the cluster into the field of view. Note how the stars are arranged in chains, a common effect in clusters. Observers in high northern latitudes will find that the proximity of M41 to the horizon dims its splendour.

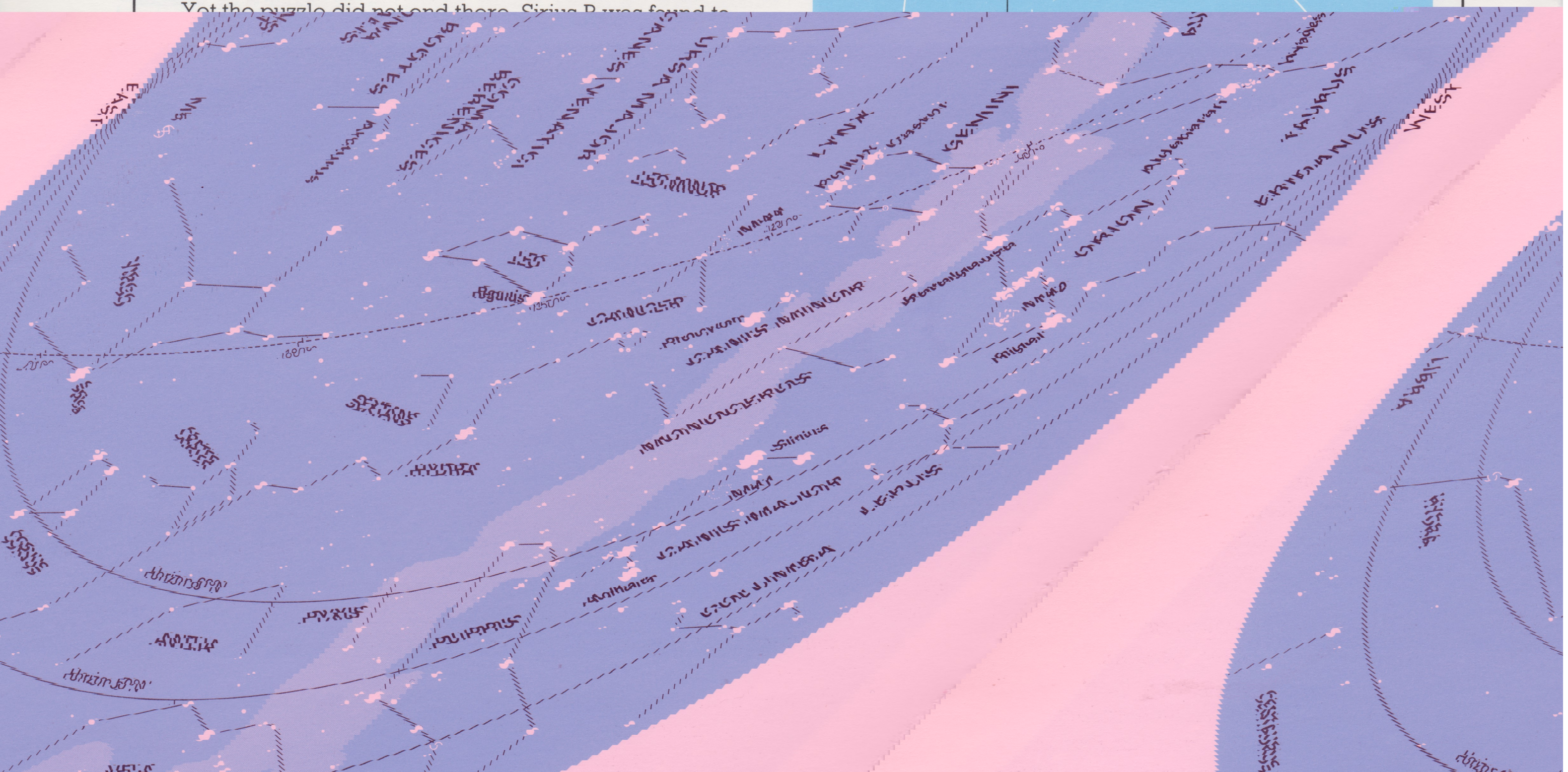
Much more compact than M41 is the cluster NGC 2362, centred on the 4th-magnitude blue-white giant Tau (τ) Canis Majoris. NGC 2362 contains about 40 members, many of them visible in small telescopes. Tau Canis Majoris itself has a light output of 20,000 Suns. Star and cluster are 5000 light years away.

WHITE DWARFS

In 1862 the American astronomer Alvan G. Clark first saw the faint companion of Sirius while testing a new 47-cm telescope. But this companion star, Sirius B, was a puzzle. Its surface was hotter than that of the Sun, yet the star itself was much dimmer than the Sun. That meant it must be very small – about 2 per cent of the Sun's diameter, only twice the size of the Earth, which is astoundingly small by stellar standards. Such a tiny, hot star is termed a white dwarf.

Yet the puzzle did not end there. Sirius B was found to





Leo

One of the few constellations that genuinely resembles its name is Leo, the lion. Legend identifies it with the lion slain by Hercules as one of his twelve labours. The lion's head is represented by a sickle-shape of six stars, like a back-to-front question mark. The body is outlined by four stars, the tail being marked by Beta (β) Leonis, a white star of magnitude 2.1 whose name, Denebola, comes from the Arabic meaning lion's tail.

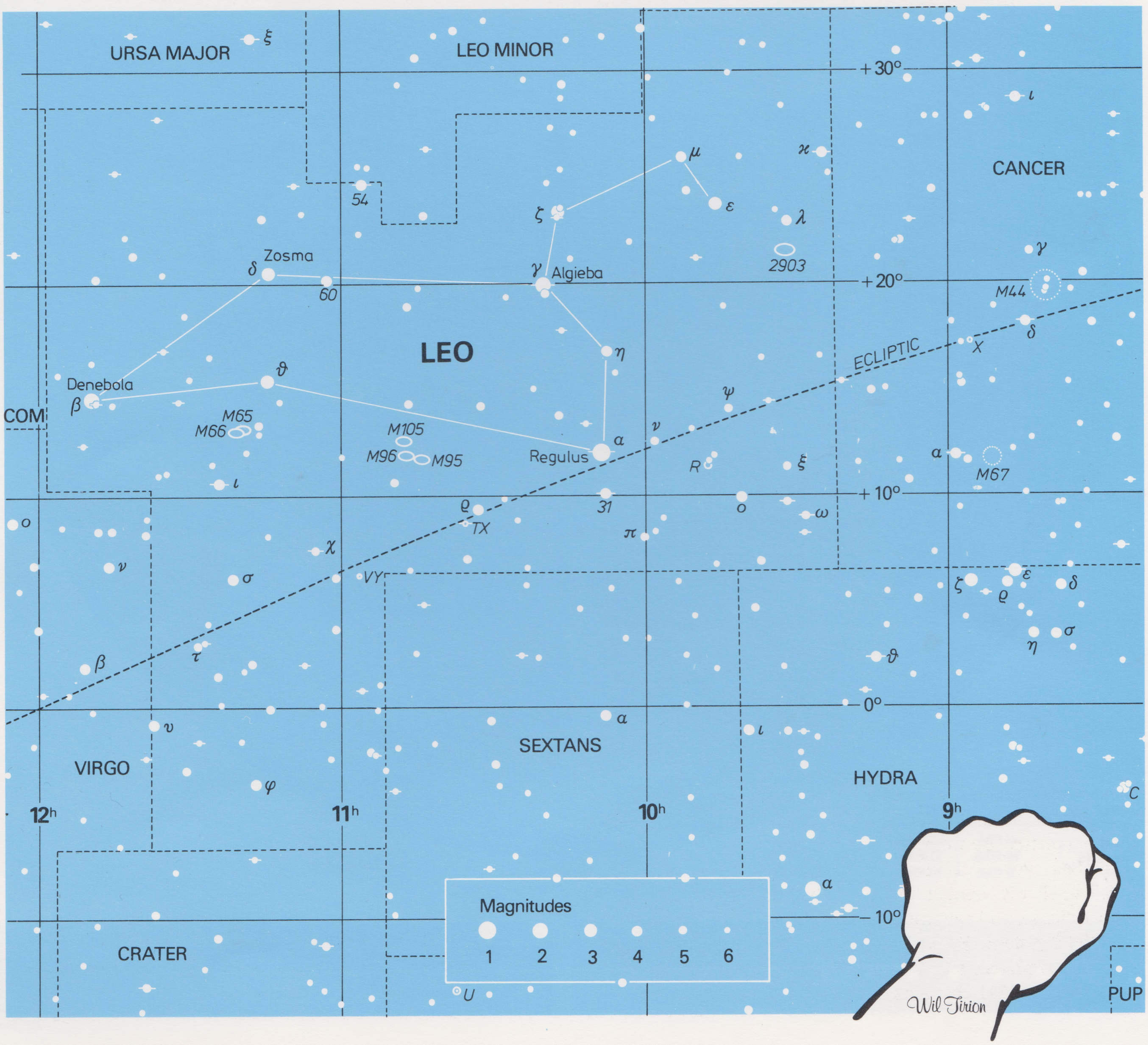
At the bottom of the sickle is the brightest star in Leo, Alpha (α) Leonis, better known as Regulus, meaning little king, appropriate for the king of beasts. Regulus appears in our skies as magnitude 1.4. It is a blue-white star 85 light years away, with an estimated diameter five times that of the Sun, and it gives out 150 times as much light as the Sun. Small telescopes or even binoculars show that Regulus has a wide companion star of 8th magnitude. Although 700,000 million km from Regulus, more than 100 times the distance of Pluto from the Sun, this companion is genuinely related, and moves through space together with Regulus.

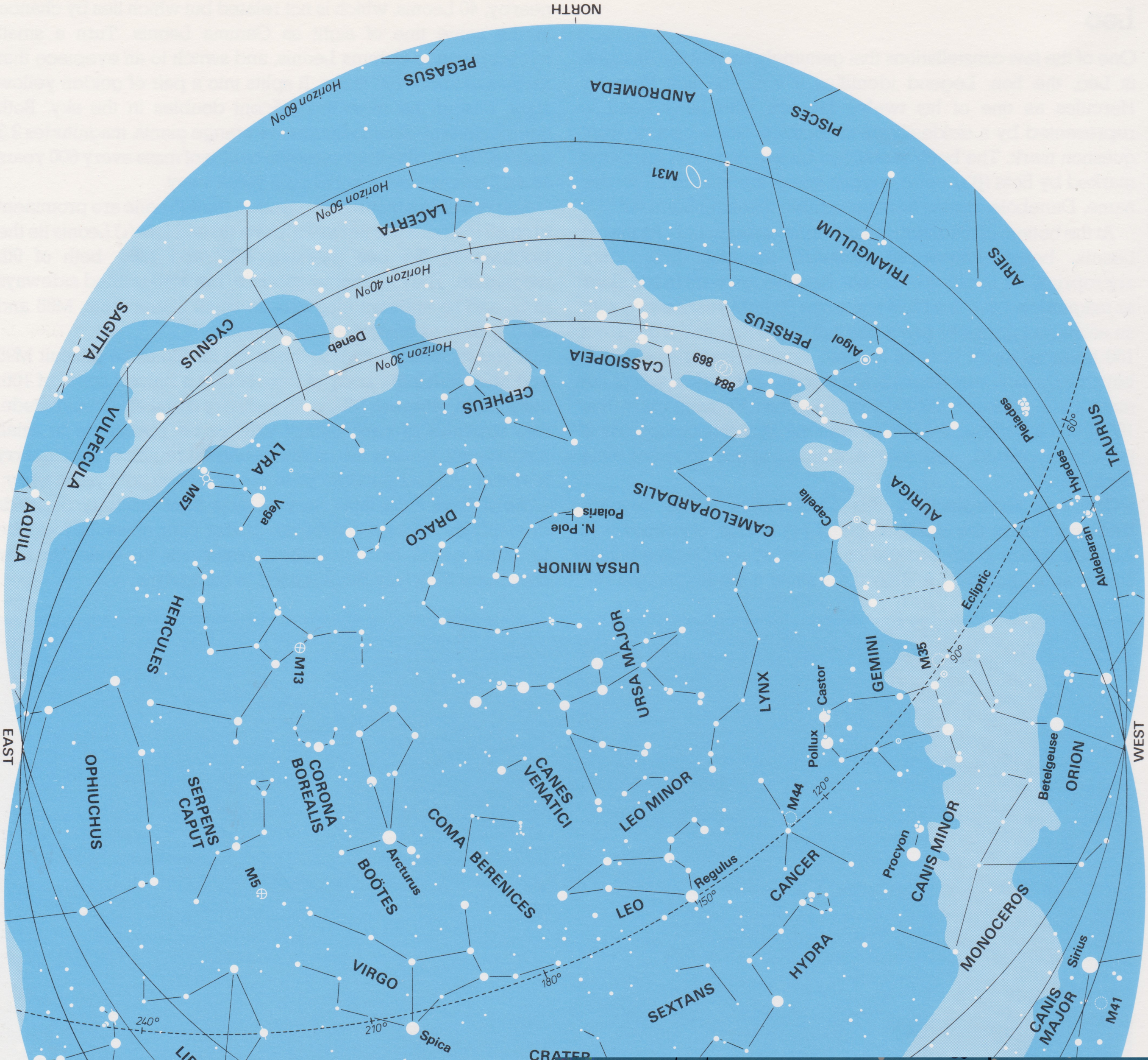
The real showpiece of this constellation is the second-brightest star in the sickle, Gamma (γ) Leonis, also known as Algieba, meaning lion's mane. To the naked eye Gamma Leonis shines at magnitude 1.9. Binoculars show a 5th-magnitude star nearby, 40 Leonis, which is not related but which lies by chance in the same line of sight as Gamma Leonis. Turn a small telescope on to Gamma Leonis, and switch to an eyepiece that magnifies about 100 times. It splits into a pair of golden yellow stars, one of the most magnificent doubles in the sky. Both components of Gamma Leonis are orange giants, magnitudes 2.3 and 3.5. They orbit their common centre of mass every 600 years or so. Gamma Leonis is 170 light years away.

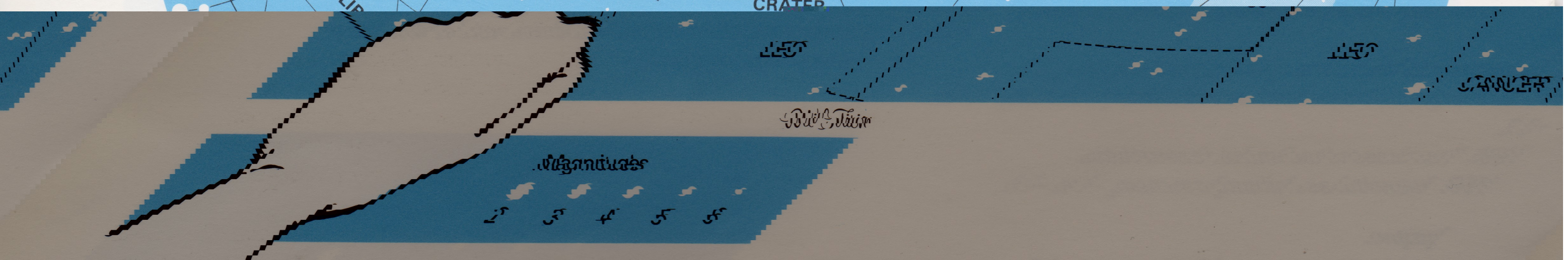
Leo contains a number of galaxies, though none are prominent in small instruments. Between Theta (θ) and Iota (ι) Leonis lie the brightest of the Leo galaxies, M65 and M66, both of 9th magnitude. They are spiral galaxies, but M65 is tilted sideways to us and so appears elliptical. In small instruments, M65 and M66 appear as misty patches of light.

If you succeed in finding these, try for the more difficult M95 and M96 under the body of Leo. M95 is a barred spiral of 10th magnitude, whereas M96 is an ordinary spiral of 9th magnitude. The structure of each galaxy will not be noticeable in small instruments, for only the brightest central region of each galaxy is visible. All four galaxies lie about 20 million light years away.

As with all such faint, hazy objects their visibility depends critically on viewing conditions. Under poor skies they will be invisible in even moderate-sized telescopes, but under the best conditions they may be glimpsed in binoculars.







Ursa Major is the third-largest constellation in the sky. The seven stars that make up the familiar saucepan shape of the Plough or Dipper are only part of the complete constellation, ...ming the rump and tail of the bear. All the stars of the ...pan are of 2nd magnitude except Delta (δ) Ursae Majoris, ...3rd magnitude.

...ost constellations in which the brightest stars have ... with each other, five of the seven stars in the ...lated, moving at the same speed and in the ...gh space. These five stars were evidently ...form a very scattered cluster. The two ...ter are Benetnasch (also known as ...lk and Dubhe, in the bowl. Over ...ons of Benetnasch and Dubhe ...considerably alter the familiar ...vious page).

The most celebrated star of Ursa Major is situated at the bend of the saucepan's handle, second from the end. Zeta (ζ) Ursae Majoris, popularly known as Mizar, magnitude [illegible]. Keen eyesight shows a 4th-magnitude star, Alcor, nearby. Mizar and Alcor are sometimes termed the horse and rider. Mizar is about [illegible] light years from Earth and Alcor is estimated to be [illegible] light years further away, so the stars are too widely separated to form a genuine binary, although they are moving through space along with the other members of the Ursa Major cluster.

But if you look at Mizar through a small telescope, you will see that it also has a much closer companion of 4th magnitude that is definitely associated with it. Precise observations over more than two centuries have confirmed that this star is very slowly moving around Mizar on an orbit that takes about [illegible] years to complete.

...form ... saucep... which ... Unlike ... no connection ... saucepan are ... same direction thro... them together, and ... non-members of the clu... Alkaid at the end of the han... long periods of time the mot... relative to the other five stars ... saucepan shape (see diagram on pre...

THE MONTHLY SKY GUIDE

This new edition of the well-known amateur guide is the first book a star-gazer needs – with it you can identify the stars and constellations visible on any night of the year in the northern hemisphere. It contains maps of the night sky for each month, realistically depicting the stars visible to the naked eye, and uniquely including a 'fist' symbol to show the scale.

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Popular Astronomy Magazine

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